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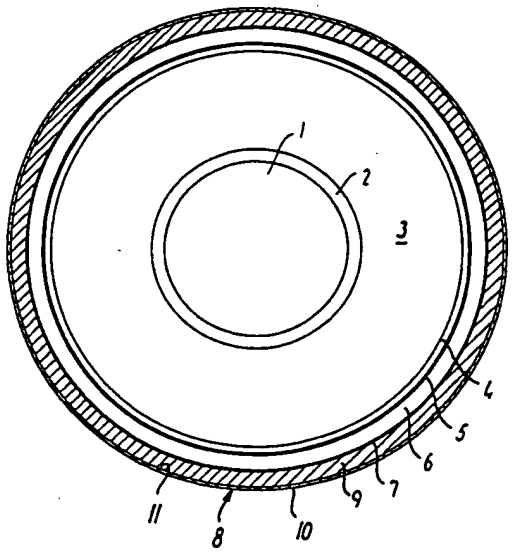
(54) A high-voltage cable

(57) A high-voltage cable is consisting of an inner current conductor (1) and a number of outer layers (2 - 10) which mainly serve the purpose of insulating the conductor from the surroundings and protect the cable from mechanical damage, moisture and corrosion. The two outer layers (9, 10) of these layers form a mantle (8) with an inner insulating layer (9) and an outer, relatively thin semiconductor layer (10). For these two mantle layers (9, 10) there are used materials which easily can be distinguished from each other. When a cable end is to be mounted in a connecting box or an end box, and the semiconductor layer (10) therefore has to be removed along a piece in order to avoid a short-circuit, the semiconductor layer (10) can thereby quickly and securely be removed manually from the underlying insulation layer (9) even under difficult working conditions. The special construction of the mantle (8) is furthermore able to reveal if the cable has been damaged during the transportation and the handling. The semiconductor layer (10) can for example be black and the insulation layer (9) can have a correspondingly contrast colour to this, e.g. being red, yellow, green or white. The materials of the two layers (9, 10) can also have structures, which can be distinguished from each other.



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Description

The invention relates to a high-voltage cable which consists of an inner conductor and a number of outer layers, which mainly serve the purpose of insulating the conductor from the surroundings and protect the cable from mechanical damage, moisture and corrosion, and where the two outer of these layers form a mantle with an inner insulation layer and an outer, relatively thin semiconductor layer.

The insulation layers of the mantle serve the purpose of a.o. protect the cable from being damaged by external stress during transportation and in connection with the laying down and the mounting. Furthermore, the mantle serves as an outer insulation and protection against corrosion, and the last-mentioned problems make heavy demands on the density of the layer.

It is therefore important to be able to observe, if this high degree of density is present in the inner layer of the insulation on a mantle of a cable laid down, and this is controlled by applying an underlying conductor layer of e.g. led a relatively high voltage. If the voltage is able to generate a current, it is taken as a sign of the fact that the insulation layer of the mantle is permeable, since there then must be a path of current in the shape of leaks between the insulation layer and the earthed semiconductor layer of the mantle. The limit for the current intensity, which represents the allowed size of the leaks, is frequently fixed to 1 milliamp.

When cable lengths are to be assembled to longer cable strings by means of connecting boxes or are provided with end boxes, it is necessary first to expose a piece of the above-mentioned conductor layers, which as said typically can be of led, by removing a piece of the insulation layer at the cable end. The exposed led layer can then be joined by means of for example soldering with a corresponding conducting connection in the box. Other conducting layers, if any, as well as the inner conductor are also exposed in order to be joined in the box in the same way.

In the finished spigot-and-socket joint the semiconductor layer of the mantle would, all things being equal, make a conducting connection between the conducting parts of the cable and the earth. Therefore, the semiconductor layer would short-circuit the currents which might run in these parts. Such a short-circuit would result in undesired current dissipation, and furthermore, a true density control of the insulation layer of the mantle would not be possible. To eliminate these disadvantages the semiconductor layer of the mantle is therefore removed from its insulation layer along a piece which extends from the exposed led layer to somewhat outside the box.

This operation is usually done manually by means of simple pieces of tools, such as a spoke shave on the place where the cable is laid down. The operator will therefore often have to work under difficult conditions, and since the semiconductor layer of the conventional mantles not with certainty is to be distinguished from the underlying insulation layer and furthermore are relatively thin, e.g. typically in sizes of 0,2 mm., the process in itself is difficult and time demanding and the result is often dissatisfactory. If there is cut to deep, the insulation layer will be damaged, and if there is not cut deep enough, the risk of short-circuit is still present.

The purpose of the invention is to provide a high-voltage cable of the type mentioned in the opening paragraph being adapted in such a way, that its semiconductor layer quickly and securely can be removed manually from its insulation layer even under difficult working conditions, and which at the same time is able to reveal if the cable has been damaged during the transportation and the handling.

The novel and characteristic features according to the invention, in which this is obtained, is that there for the two mantle layers are used materials, which are easy to distinguish from each other, whereby the operator securely can identify the limit between the two layers, when the semiconductor layer of the mantle is to be removed from its insulation layer at an cable end which is to be joined in a box. If the cable should be damaged during the transportation and/or in connection with the work of laying down the cable, the damaged area will furthermore be revealed in those cases, where the damage has uncovered the insulation layer.

The two mantle layers are especially easy to distinguish from each other when their materials are of different colours.

The two outer mantle layers can with advantage be made of plastic with an additive of carbon black in an amount of by way of example 30% in order to make the layer to be conductive. In this case, the outer mantle layer will take the black colour of the carbon black. The inner mantle layer can then be made of polymeres, such as polyethylene, polyvinyl chloride or polyurithane with a different colour than black.

When the operator during the work with removing the outer mantle layer observes this different colour appearing, it will for him be the signal of having reached the limit between said two layers, and that there must not be removed any more material on this spot. If the different colour, on the other hand, has not yet appeared, the operator oppositely will know that there still remains somewhat of the material of the outer mantle layer to be removed.

The different colours of the materials therefore efficiently determine the work of the operator and thereby ensures an optimum result, where the outer mantle layer efficiently has been removed without having damaged the inner mantle layer.

In order to obtain a good contrast to a black, outer mantle layer, the material of the inner mantle layer can furthermore with advantage be red or white.

By a second embodiment according to the invention the operator will be able to distinguish the materials of the two mantle layers from each other by their different structure.

If the material of the outer mantle layer has a struc-

ture such as being more coarse and/or more soft than the material of the inner mantle layer, then the operator will physically be able to registrate the limit between the two mantle layers, when he, when during the work of removing the outer layer, can ascertain that the material has changed character.

The invention will be explained more fully below with reference to the only figure of the drawing showing a high-voltage cable according to the invention.

The embodiment shown is only to be understood as an example, and the cable can within the scope of the invention be constructed in many other expedient ways. The main point is, that the cable at the outside is provided with a mantle with an inner insulation layer and an outer, relatively thin semiconductor layer.

As it can be seen, the cable is build up by a number of layers, which in order to give an overall understanding, briefly is mentioned in the following.

The real conductor 1 of the cable, which conductor is serving the purpose of transmission of the electric current, is in the middle of the cable. In high-voltage cables such a conductor will usually have a relatively large diameter, which e.g. can be approximately 50 mm, and the conductor is therefore typically divided into a number of sectional wires in order to provide the cable with an adequately large flexibility allowing the cable to be wounded up upon a cable drum and follow the differences of level of the terrain.

The wires consist of copper and/or aluminium, and the inter-space between the wires are filled with swelling powder and semiconducting tape (not shown). Innermost there can furthermore be arranged a solid core of aluminium (not shown)

Around the conductor a conducting screen 2 has been extruded in the shape of an inner semiconductor serving the purpose of equalizing the electric field around the sectional wires of the conductor.

Next there is an extruded insulation 3 of e.g. crosslinked polyethylene for insulating the conductor from the surroundings.

Around this insulation there has been extruded an insulation screen 4 consisting of a semiconducting material and serving the same purpose as the conductor screen 2, namely to equalize and homogenize the field.

A band winding 5, which has been wounded around the insulation screen 4, makes a termic barrier, with the purpose of preventing the plastic from melting. The winding consists of craped carbon paper and swelling band which swells, when it is exposed to water, and thereby forms an obstruction for moisture which tries to penetrate along the cable.

At the outside of the band winding 5 there is furthermore a led mantle 6 for protecting the cable from being penetrated by moisture and for carrying a short-circuiting current.

Around this led mantle 6 there has been wounded a band winding 7 of for example polyester. This winding functions as a termic barrier to prevent the plastic from melting.

At the outside there has finally been placed a mantle 8 with an inner insulation layer 9 of for example polyester and an outer, relatively thin semiconductor layer 10 of plastic to which has been added carbon black in a proportion of for example 30% in order to make the layer semiconducting.

As mentioned before, the insulation layer 9 of the mantle 8 serves the purpose of functioning as an outer insulation to the cable and protect it from mechanical damage and corrosion, while the superjacent semiconductor layer 10 functions, when the density of the insulation layer 9 is to be tested.

In order to avoid short-circuits it is necessary to remove a piece of the semiconductor layer 10 at a cable end, which is being mounted in a cable box. This process is usually performed manually by means of simple pieces of tool, such as e.g. a spoke shave. By conventional mantles the two layers 9, 10 are, however, difficult to distinguish from each other. This is e.g. the case when they both are black.

The semiconductor layer 10 is furthermore relatively thin, e.g. about 0.2 mm, and the operator will therefore have to be extremely careful in order not to cut too deep and damage the insulation layer 9 or oppositely leave semiconducting deposits 10, which might be the course of a short-circuit.

The work of removing the semiconductor layer 10 on conventional mantles is therefore in itself difficult and time demanding, and to this can be added that the operator will be unable to give the work the necessary care under these difficult working conditions, which frequently take place on the laying place of the cable. When the semiconductor layer is removed on conventional cables, the result will therefore often be dissatisfactory.

When the operator is to remove the semiconductor layer 10 on a mantle 8 according to the invention he can, however, easily registrate when the limit 11 between the two layers has been reached, and he will therefore be able to perform his work in a quick and secure way and with the optimal result aimed at.

A second advantage is, that the special construction of the mantle 8 can reveal, if a cable has been damaged during the transportation and the handling to such a degree that some of the insulation layer 9 of the mantle 8 has been uncovered.

In order easily to be able to distinguish the two layers 9, 10 of the mantle 8 from each other, they are, according to the invention, made of materials, which have different colours and/or structure.

By a first embodiment according to the invention, the plastic material of the semiconductor layer 10 can, for example, be coloured black by a content of carbon black in order to make the plastic semiconducting, and the material of the insulation layer 9 can then have a correspondingly contrasting colour, which e.g. can be red, yellow, green or white.

By a second embodiment according to the inven-

tion, the materials of the two layers 9, 10 can have structures which can be distinguished from each other. For example can the plastic material of the semiconductor layer 10 be more coarse and/or more soft than the material of the insulation layer 9.

A particular expedient embodiment is obtained by combining the first and the second embodiment so that it is possible to distinguish the materials of the two layers 9, 10 from each other as well physically as visually.

Claims

1. A high-voltage cable which consists of an inner conductor and a number of outer layers, which mainly serve the purpose of insulating the conductor from the surroundings and protect the cable from mechanical damage, moisture and corrosion, and where the two outer of these layers form a mantle with an inner insulation layer and an outer, relatively thin semiconductor layer, **characterized** in that there for the two mantle layers are used materials which easily can be distinguished from each other.

2. A high-voltage cable according to claim 1, **characterized** in that the materials of the two mantle layers have different colours.

3. A high-voltage cable according to claim 1 or 2, **characterized** in that the material of the out mantle layer is black, and that the material of the inner mantle layer is not black.

4. A high-voltage cable according to claim 1, 2 or 3, **characterized** in that the material of the outer mantle layer is black and that the material of the inner mantle layer is red.

5. A high-voltage cable according to each of the claims 1 - 4, **characterized** in that the material of the outer mantle layer is black, and that the material of the inner mantle layer is white.

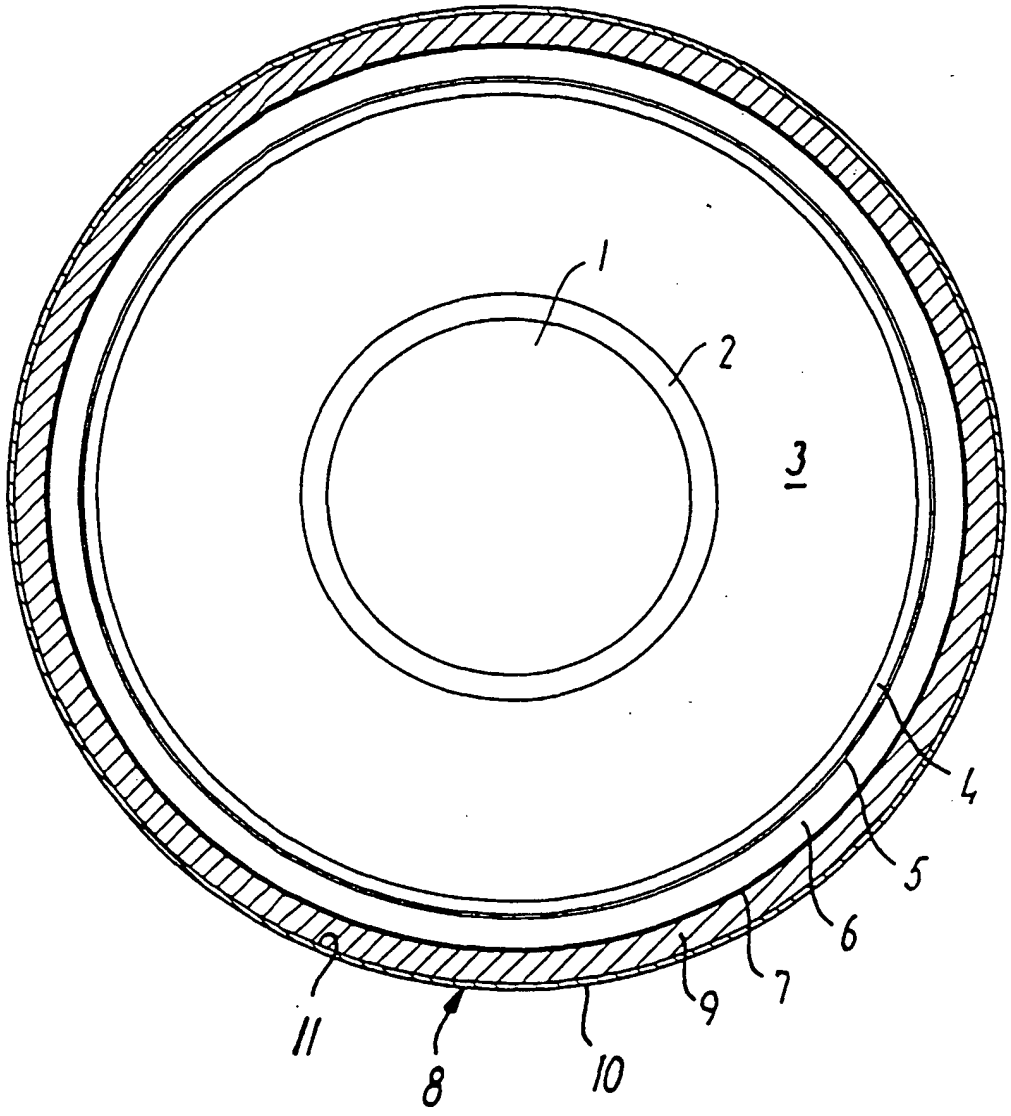
6. A high-voltage cable according to each of the claims 1 - 5, **characterized** in that the materials of the two mantle layers have different structure.

7. A high-voltage cable according to each of the claims 1 - 6, **characterized** in that the material of the outer mantle layer has a more coarse structure than the material of the inner mantle layer.

8. A high-voltage cable according to each of the claims 1 - 7, **characterized** in that material of the outer mantle layer has a structure which is more soft than the structure of the material of the inner mantle layer.

9. A high-voltage cable according to each of the claims 1 - 8, **characterized** in that the inner layer of the mantle is produced of a polymere such as polyethylene, polyvinylchloride or polyurithane.

10. A high-voltage cable according to each of the claims 1 - 9, **characterized** in that the outer layer of the mantle is produced of a plastic with an additive of carbon black.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